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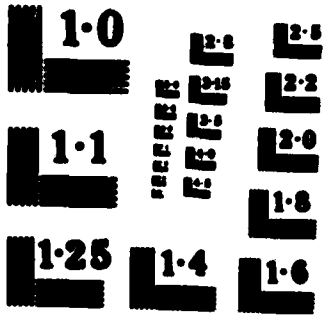
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CELLULAR MECHANISMS OF CENTRAL NERVOUS MODULATION

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Scientific Activities

As indicated in the previous report experiments are in progress on regenerating nervous connectives. These experiments involve ultrastructural and electrophysiological studies of the neuroglia and axons in cut and in ligated cockroach connectives.

Detailed electron microscopic observations show that cutting of penultimate connectives induces massive glial growth, synthesis of extracellular matrix and degeneration of axons which are separated from their cell bodies. The activated neuroglia show no evidence of becoming modified to form limiting junctional complexes that restrict the inward intercellular movement of exogenous tracers.

Intracellular recordings from identified giant axons (cobalt injected) confirmed the ultrastructural observations in showing a rapid loss of the resting and action potentials when separated from their cell bodies by severance of the connectives. In contrast the axons from cut connectives that retained connection with cell bodies maintained both their resting and action potentials. Interestingly, axons from ligatured and cut connectives maintained their resting potentials when separated from their cell bodies, for up to 137 days. The action potentials from these axons declined and excitability was abolished within 3 to 7 days.

The above observations suggest that the maintenance of axonal excitability is dependent upon the presence of the cell body. We shall test the hypothesis that this results from the synthesis of voltage-sensitive ion channels by the cell body and subsequent axonal transport.

The retention of the axonal resting potential in ligatured preparations, obviously implies that there is continued maintenance (>137 days) of linked Na/K pumps, which maintain ion gradients, and the voltage-insensitive ion channels which are not immediately dependent upon the presence of the cell body. We shall test the hypothesis that this maintenance results from the activity of the associated neuroglia which in recent experiments (cf. Lasek & Tytell, J. exp. Biol.

95, 153) have been shown to be involved in a substantial macromolecular protein transfer to the squid giant axon.

Attempts have been made to maintain whole cockroach nerve cords in vitro (using organ culture techniques) in an attempt to study the chemical control of glial activation. Only limited success has been so far achieved, as judged by the electrical excitability of the giant axons. Using our present procedure the cords only maintain axonal excitability for < 7 days. We are currently modifying the cultural conditions in an attempt to prolong the in vitro survival of the nerve cords.

Future Research Plans

It is proposed to continue observations on the electrophysiology of neuroglia and, particularly, to characterize the electrical responses of the superficial neuroglia to alterations in external ion concentrations. A quantitative model will be attempted which will then be used to elucidate the effects of externally-applied octopamine and other pharmacologically-active compounds on the electrical responses of the neuroglia.

If our attempts to culture whole nerve cords are successful, then an attempt will be made to investigate the nature of the control of glial growth and proliferation following injury.

Significant administrative actions

Dr. Colin Leech has gained a permanent appointment and will be resigning his assistantship with effect from 1st August 1982. A suitable replacement is being sought.